Accuracy of non-contrast MRI for the evaluation of appendicitis

Iva Petkovska[1], Bobby Kalb[1], Shannon Urbina[1], Matt Covington[1], Puneet Sharma[1], Hina Arif[1], and Diego Martin[1]
[1]*Medical Imaging, The University of Arizona, Tucson, Arizona, United States*

Target audience: Clinicians.

Purpose: To evaluate the sensitivity and specificity of MRI for the detection of acute appendicitis in patients ≤ 40 years old presenting to the emergency department (ED) with right lower quadrant pain (RLQP), primarily using only single shot partial Fourier spin echo-train T2 weighted images with and without fat-suppression, and without the use of either intravenous (IV) or oral contrast agents.

Materials and Methods: This is an IRB-approved and HIPPA-compliant prospective study of 189 patients. A cross-departmental protocol, coordinated between ED and Radiology, was instituted to obtain MRI as the primary diagnostic modality for all patients ≤ 40 yo presenting to the ED with RLQP and a clinical concern for acute appendicitis requiring imaging evaluation. A total of 189 consenting patients were enrolled between 8-2012 and 9-2013. All MR exams were performed on either a 1.5T/3.0T system (Siemens Medical Solutions, Aera/Skyra) using posterior fixed coils and anterior abdominal and pelvic surface coils. Images were acquired without breath holding using Half-Fourier Single-shoT Echo-train (HASTE) T2 in the coronal, axial, and sagittal planes. HASTE acquisitions were repeated with fat-suppression using SPectral Adiabatic Inversion Recovery (SPAIR). Image resolution was between 1.5-2.0 mm in plane and 7 mm out-of-plane with 10% gap. All MRI results used for this study are based upon the prospective interpretations immediately following study acquisition. The dictated results were recorded into the clinical record and this record retrospectively analyzed. One of 7 body MRI radiologist specialists performed the clinical interpretations. Results were categorized as a) positive, b) negative or c) indeterminate for acute appendicitis. Clinical outcomes were determined by either a) surgical findings or b) phone call follow-up interviews with the patients 8 weeks after presentation, combined with review of the patient's medical records to note any other evaluations and results.

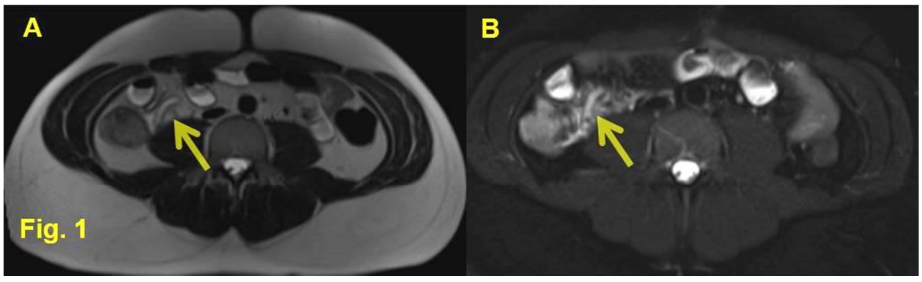
Results: Of 189 patients enrolled in this study with RLQP, 32 exams were categorized on MRI as positive for acute appendicitis (Fig 1.) and 150 exams were categorized as negative for acute appendicitis; no patients were categorized as indeterminate in our patient population. Using the reference standards of surgery (n=39) or phone call interviews and medical chart reviews (n=150), MRI demonstrated sensitivity 100 % [95% CI: 88.7 % to 100.00 %], specificity 99 % [95% CI: 96.5 % to 99.9 %], NPV 100 % [95% CI: 97.7 % to 100.00 %], and PPV 97 % [95% CI: 83.7 % to 99.5 %]. An alternate diagnosis was offered in 84/157 (55%) cases negative for acute appendicitis; the most common alternative diagnosis are shown in Table 1. The total room utilization time averaged 14 minutes. No technical failures or aborted studies were encountered. No adverse clinical events were detected on patient follow up for exams reported as negative for any active disease. One false positive study described acute appendicitis on the report but was shown to be a ruptured ovarian cyst on surgery.

Discussion: While our study shows excellent results for sensitive and specific diagnosis of appendicitis, limitations include the potential bias related to patients who did not enroll in this study. There was a single false positive patient who was taken to surgery for a non-surgical pathology, however our results compare favorably to prior reports using CT for assessing RLQP. Furthermore, our protocol minimized preparation and scanning time by omitting use of oral contrast agent, prior to the study, or the need for administering IV contrast during the study.

Conclusion: MRI is a highly accurate test for the evaluation of patients ≤ 40 yo with acute RLQP and a differential diagnosis of acute appendicitis utilizing a rapidly acquired imaging protocol that is relatively insensitive to breathing-related motion and performed without use of IV or oral contrast.

References: [1] Lubarsky et al. RadioGraphics 2013;33(2): 313–337. [2] Pedrosa et al. RadioGraphics 2007;27(3):721–743; discussion 743–753. [3] Lauenstein et al. JMRI 2008 27(6) 1448-54 [4] Leeuwenburgh et al. Radiology 2013 268(1):135-43

Figure 1. [A] axial T2 [B] axial T2 FS. A yellow arrow points to the appendix, which is fluid filled, with marked surrounding inflammation in keeping with acute appendicitis.
Table 1. Number of cases with the most common alternative diagnosis.



MRI (n=189)	Number cases
Enteritis/Colitis	34
Ovarian torsion	4
Acute pancreatitis	3
Mesenteric adenitis	3
Pyelonephritis	3
Ovarian Cyst Rupture	2
Hepatitis	2
Endometriosis	2
Chorioamnionitis	1
Table 1	